TRAINING OF HYDROLOGICAL OBSERVERS AND TECHNICIANS-ACTION PLAN

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ABSTRACT

The development of water resources for meeting increasing demands of steeply rising population of the country has posed many problems for all involved in this task, particularly hydrologists and water resources engineers. India's vast water resources are unevenly distributed in space and time, and severe droughts and heavy floods are quite common. The hydrological environment is in a state of continuous change due to man's activities. For dealing with various hydrological problems in water resources development and management, vast manpower resource with specialised knowledge and training in hydrology at different levels is needed. This includes: professional hydrologists, junior hydrologists, hydrological technicians and hydrological observers. Since this sub-professional level is less homogeneous in comparison to professional levels. There is a large variety of background of previous schooling, medium of instructions, exposure to training etc. There is an urgent need for embarking upon a comprehensive programme for training of hydrological technicians and observers in the country for developing various skills and abilities including understanding of the basic hydrological processes and their observation, and use of modern data management techniques. No training programme could be considered without considering the training of teachers/instructors who will be responsible for providing training to technicians and observers.

The present paper proposes a comprehensive action plan for simultaneously taking-up the training of teachers/instructors, technicians and observers. Suggestions have also been made for syllabii, duration of training and possible places where such training could be imparted.

INTRODUCTION

The attainment of economic self-reliance and raising the living standard are the two main objectives of sound planning for development. The main aim of the planning is to allocate available resources of water, land, manpower etc. in a manner so as to maximize the achievement of desired social and economic objectives. This requires development of outlook, knowledge, methods and equipment; so as to cater for changing conditions due to developmental efforts and also for taking due care of environmental aspects. The science and technology to achieve the desired objectives have to be developed or adapted so as to suit the typical environment as represented by climate. availability of resources of land, water, manpower, finances etc., and social and political factors. The useful technology developed elsewhere will have to be screened, selected, and modified for adaptation by suitably trained manpower. The need for properly trained manpower is growing particularly for planning and optimal utilisation of vital resource of water to meet demands of rising population for various uses.

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The water is one of the important and vital natural resources available to mankind. Due to its multiple benefits and the problems created by its excesses (floods), shortage (droughts) and quality deterioration, it requires special attention. India with its geographical area of 3.27 million sq.km has an average annual precipitation of the order of 400 million ha-m including snowfall in high altitude areas. Most of this precipitation occurs on an average of 75 days of the year of which about 180 million ha-m flows as surface runoff including that regenerated from groundwater. The total utilisable surface water is estimated as 70 million ha-m out of which only 40 percent is the present utilisation. The total utilisable groundwater is estimated as 42 million ha-m.

The uncertainty of monsoon rainfall and uneven distribution in space and time has been the main cause for slow rate of growth. There is need for integrated development of surface and groundwater after assessing their availability and distribution in space and time, and also to operate water resources projects to achieve maximum benefits.

Nearly 85% of the present use of water has been for agriculture. Domestic and industrial water needs have largely been concentrated in or near principal cities. The growth process, the increase in population and the expansion of economic activities inevitably lead to increasing demands for water use which is estimated to be of the order of 105 million ha-m by the year 2025 A.D.(CWC , 1987). To store the water from monsoon season for use in the subsequent seasons, there is need for building up of large storage capacity in reservoirs and storage tanks. CWC (1987) mentions about storage so far created or under construction as 25 million ha-m, and from projects under consideration another 6.6 million ha-m would be forthcoming. The National Water Policy recently adopted by Government of India aims at optimum and efficient utilisation of the country's water resources for the benefit of entire nation by adopting improved methodology for basinwise development, conjunctive use of surface water and groundwater, and by interbasin transfer of surplus water to needy areas. The policy document recognises the importance of a well developed information system with a network of data banks and data bases, with improved quality of data and the processing capabilities. It further states that the frontiers of knowledge have to be pushed forward in several directions by intensifying research efforts and a perspective plan for standardised training has to be formulated for all categories of personnel. (National Water Policy, 1987).

ROLE OF SCIENTIFIC HYDROLOGY

Hydrology has been defined as the science that treats of the waters of the earth, their occurrence, and distribution, their chemical and physical properties and their reaction with their environment including their relation to living things. The important role of scientific hydrology was felt all over the world, and in 1961 at a meeting in Athens, International Programme was considered leading to launching of International Hydrological Decade (IHD) from January 1965.

The scientific programme included studies of (i) water balance, (ii) qualities of natural waters, (iii) erosion, transport and deposition of sediments, and (iv) man's influence on hydrological phenomena. The subsequent programmes under IHP II and IHP III gave increased emphasis to various areas and subareas of hydrology including environmental aspects, manpower development etc. The hydrologic appraisal of water resources is the basic requirement for planning, designing, constructing and operating water resources projects. Its objective is to determine the source, extent, and dependability of supply and the character of water on which an evaluation of control and utilization is based. The appraisal involves, the collection and utilization of hydrologic information and data which include precipitation, river stage, river discharge, sediment transportation, yield and storage of groundwater, quality of water and hydrometeorological data. This data forms the source of information upon which quantitative hydrologic investigations are generally based

The information from large amount of hydrologic data can be suitably expressed in statistical terms and treated using probability theories, for prediction of future probabilities of hydrologic events like floods and droughts, availability of water or yield from basins etc. Prior to independence, there were very few gauge and discharge sites in India. Measurement of the flows was instituted in 1921 at all important points on the Indus and its tributaries. It was only in the second half of the century that observation sites were set upon on a large scale. Rao (1975) estimated a total of 1700 stations for major, medium, minor and desert basins as per WMO norms as against existing 423 stations maintained by Central agencies. The author also mentions about 1653 stations maintained by States. There have been improvement in network for hydrological measurements in subsequent years. While discussing water resources development scenerio for India, Shah (1987) predicts that entire utilisable water resources will have been fully utilised by 2025 AD and emphasizes the need for optimal development and efficient utilisation of water as a national resource. This would require a well established standardised national information system with a network of data banks, data bases and measurement/observation stations in river basins. In order to meet the needs of short term and long term plans for water resources development men of specialised training and knowledge in hydrologic investigations and analysis will be needed at different levels. These levels of training are broadly categorised as follows:

1. Professional Hydrologists
2. Junior Hydrologists
3. Hydrological technicians
4. Hydrological observers.

NEED FOR TRAINING OF TECHNICIANS AND OBSERVERS

The greatest manpower need in hydrology is for subprofessional level of technicians and observers. The lack of skilled hydrological technicians in the developing countries has been considered as a major constraint to a balanced development of water resources. The great need for training of personnel at this level has long been recognised by UNESCO and several courses had been organized in a number of regions, starting with 1st & 2nd regional courses in Zambia held in 1972 and 1974. The third course was held in Kenya in 1977 and fourth course in Zambia in 1987. UNESCO (1984) report on fifth regional course held in Zimbabwe recommends in addition to the standard three months training course, other types of courses aimed at technicians in advanced positions. Altogether about 150 technicians benefitted from these five courses. The regional training course for hydrology technicians sponsored by the UNESCO started in Kathmandu, Nepal in 1982 (ARCCOH NEWSLETTER 1985). In the four courses upto 1986, 33 participants from different countries have been trained besides those from Nepal, as follows:

(i) Afghanistan -1
(ii) Bangladesh -6
(iii) Bhutan -2
(iv) Burma - 5
(v) India - 6
(vi) Pakistan- 5
(vii) Sri Lanka-8

ARCCOH NEWSLETTER (1986) mentions about two types of International Hydrology Technicians Training Courses of three months and six months duration sponsored by UNESCO proposed by Pakistan Council of Research in Water Resources. The main objectives of these courses are:

(i) To improve the skill, competence and efficiency of hydrolog technicians,

(ii) To familiarize with latest techniques for field work,

(iii) To demonstrate the effectiveness of modern equipment in genera ting, processing and analysing hydrological data.

(iv) To widen the knowledge regarding technical aspects of hydrologic analysis and design,

(v) To increase the availability, use and exchange of hydrologic information.

The IHP III project 14.1 C also emphasizes the need for the training of teachers of technicians and of guidance material on the teaching methods. While technicians are the field personnel in hydrology who gather and process the field data, the teachers/instructors are experienced technicians or engineers with a practical background and with responsibility for field operations.

Inspite of important role of technicians and observers, there is no regular course for technicians' training. Various organisations like Central Water Commission, India Meteorological Department, Central Groundwater Board, State Irrigation Departments etc. dealing with areas related with different components of hydrologic cycle meet their personnel requirements by recruiting people fresh from universities and technicial institutions. Usually, the personnel acquire some background and proficiency in measurement and processing techniques on the job itself. Some organisation conduct their own training programmes for the inservice personnel to suit their specific requirements. The need for an integrated training of technicians in different phases of the hydrologic cycle has been felt since long.

The High Level Technical Committee on Hydrology (HILTECH) in its first meeting held in Feb.1983 appointed a subcommittee to consider various aspects of training of technicians and suggest short term in-house and on the job training programmes. After a number of meetings and discussions ,the subcommittee has suggested 8 week training course covering following:

(i) Applied Mathematics and Statistics	20 Hrs.
(ii) Hydro Chemistry	15 Hrs
(iii) Hydro Geology(only for Groundwater Group)	-30 Hrs
(iv) Surveying and Map Reading	-20 Hrs
(v) Hydrometry(only for Surface water Group)	- 30 Hrs
(vi) Hydrometeorology	-30 Hrs
(vii) Basic Hydrology	-25 Hrs
(viii) Data Processing	-25 Hrs
(ix) Data Storage Devices including computer	-15 Hrs
(x) Regional Typical subjects (Such as Snow Hydrology, Coastal hydrology, forest hydrology, urban hydrology, Limnology etc.)	-20 Hrs
(xi) On the job field training, tests and assignments etc.	-60 Hrs

There is a large variety of background of previous schooling, medium of instruction, work experience etc. amongst personnel working at hydrological technicians and observers levels in different organisations/parts of the country. For any training activity at these levels, the focus has to be on transfer of specific skills rather than theoretical coverage of subject matter. These would include:

(i) Ability to describe the nature and the effect of important properties of water, and to understand concept of water balance and hydrologic cycle.

(ii) Ability to understand the concept of climate and general features of Indian monsoon.

(iii) Ability to observe various meteorological and hydrological parameters using different types of instruments with different degrees of sophistication.

(iv) Ability to carry out preliminary processing and analysis of hydrometeorological and hydrological data.

(v) Ability to use modern data handling machines, computer etc.

(vi) Ability to maintain data records and transmit data in appropriate formats.

No training programme and particularly that for hydrological technicians and observers for a country of the size of India could be considered without considering the training of teachers/instructors who will be responsible for providing training. Only through such training of instructors, a degree of uniformity could be introduced and multiplying effect could be achieved leading to overall improvement of hydrological investigations and data base in the country.

Chawla (1987) mentions about a recent study by Venkatesan which estimates the number of engineers needed for the management of 75 million ha of irrigated land as about 140000. The author emphasizes the need for systematic study for estimation of manpower requirements at various levels and under various specializations for water resources development activities in the country.

Though there has not been any systematic study and assessment of manpower needs at technicians' and observers levels, keeping in view increased pace of development of water resources to meet demands for various uses for rapidly growing population, the following figures could be assumed for next 15 years covering period upto 2000 AD or so.

(1)	Observers	- 15000
(2)	Technicians	-5000
(3)	Instructors	- 500

HILTECH in its tenth meeting held on 9th July 1987 considered the report prepared by the sub committee on technicians training and action plan emerging out of the recommendations of the sub committee and needs in this area. With measurements being taken up at more sites on tributaries and main rivers by States, the immediate need for training of observers and technicians was emphasized. Suggestions were made regarding use of facilities created in States through establishment of WALMI's and staff training institutes. An early action was suggested by States to organise appropriate training programmes till some coordinated programme could be implemented. Keeping in view these recommendations and suggestions, action plan for training has been proposed for next five years as discussed in next section.

PROPOSED ACTION PLAN

In the proposed action plan, the problem has been dealt with in a comprehensive manner by simultaneously taking up the training of teachers/instructors, technicians and observers. It is considered reasonably to assume that around 160 technicians and 600-800 observers are trained every year over a five year period, at the end of which the status could be reviewed. The requirement of teachers/instructors for carrying out on the job training of existing personnel as well as new recruits over a period of 5 years has been assumed at around 100. The main features of the plan are as follows (Fig.1):

(A) Observers Training-[to train 3000 to 4000 persons over a period of five years]

(a) They represent gauge assistants or surveyors or equivalent level staff in CWC, or observers in IMD having 8 to 10 years of schooling.

(b) The main emphasis of training has to be on transfer of required skills keeping in view background of participants. Theoretical background to be provided to the extent necessary covering hydrology, hydrometeorology, charts and forms, equipment maintenance etc.

(c) Duration of training course- 2 to 3 weeks.

(d) Trainees for each course- around 30 to 40.

(e) Locations- At desired number of locations for each state/central organisation at desired frequency to meet specific requirements of the concerned state/organisation.

(f) Approximate financial requirements:
(i) per participant Rs.500 to 600
(ii) per course Rs.15000 to 25000

(B) Technicians Training- [To train 600-800 persons over a period of 5 years]

(a) They represent junior engineer having diploma/degree in CWC or senior observers/scientific assistants in IMD.

(b) The main emphasis of training has to be on transfer of skills and abilities as well as adequate theoretical background with stress on concepts covering subjects like mathematics and statistics, hydrochemistry, hydrogeology, surveying and map reading, hydrometry, hydrometeorology, basic hydrology, data processing and data storage devices including computer, special area hydrology etc.

(c) Duration of training course- 2 to 3 months.

(d) Trainees for each course-around 20-30

(e) Location- Technical Teachers Training Institutes located at Chandigarh, Bhopal, Calcutta and Madras, or 4 well established and suitably located polytechnics or other institutes in States (as may be feasible) to cater to the needs of training requirements of different part of the country.

(f) Frequency- 2 courses to be organised per year at each of the locations.

(g) Approximate financial requirements

(i) Per participant - Rs.2500 to 3000
(ii) Per course - Rs.0.5 lakh to 1 lakh.

(C) Teachers/Instructors Training[To train 100 persons over a period of 5 years]

(a) They represent assistant engineers or equivalent level officers having Bachelor's degree in engineering or Master's degree in science.

(b) The main emphasis of training has to be on providing professional background and training skills for training of hydrological technicians and observers including development of course material for training.

(c) Duration of training course- 4 months in two stages of 2 months each year.

(d) Trainees for each course-20

(e) Location/organisation- Department of Hydrology, University of Roorkee and Anna University, Madras where excellent facilities have developed over the years, by rotation in active collaboration with technical teachers training institutes and concerned field organisations like Central Water Commission, India Meteorological Department, Central Ground Water Board etc.

(f) Frequency- one course per year.

(g) Approximate financial requirement.
(i) Per participant -Rs.8000 to 10000
(ii) Per course - Rs.1.5 lakh to 2 lakhs

Besides, the financial requirements indicated above, it would be necessary to provide funds for creation of some additional infrastructural facilities, audio-visual aids, computational aids etc. at various places of training. Approximate financial requirement for the proposed plan over a five year period could be as follows:

	Rs. in lakhs
(1) Observers training	25.0
(2) Technicians training	15.0
(3) Instructors training	15.0
	55.0

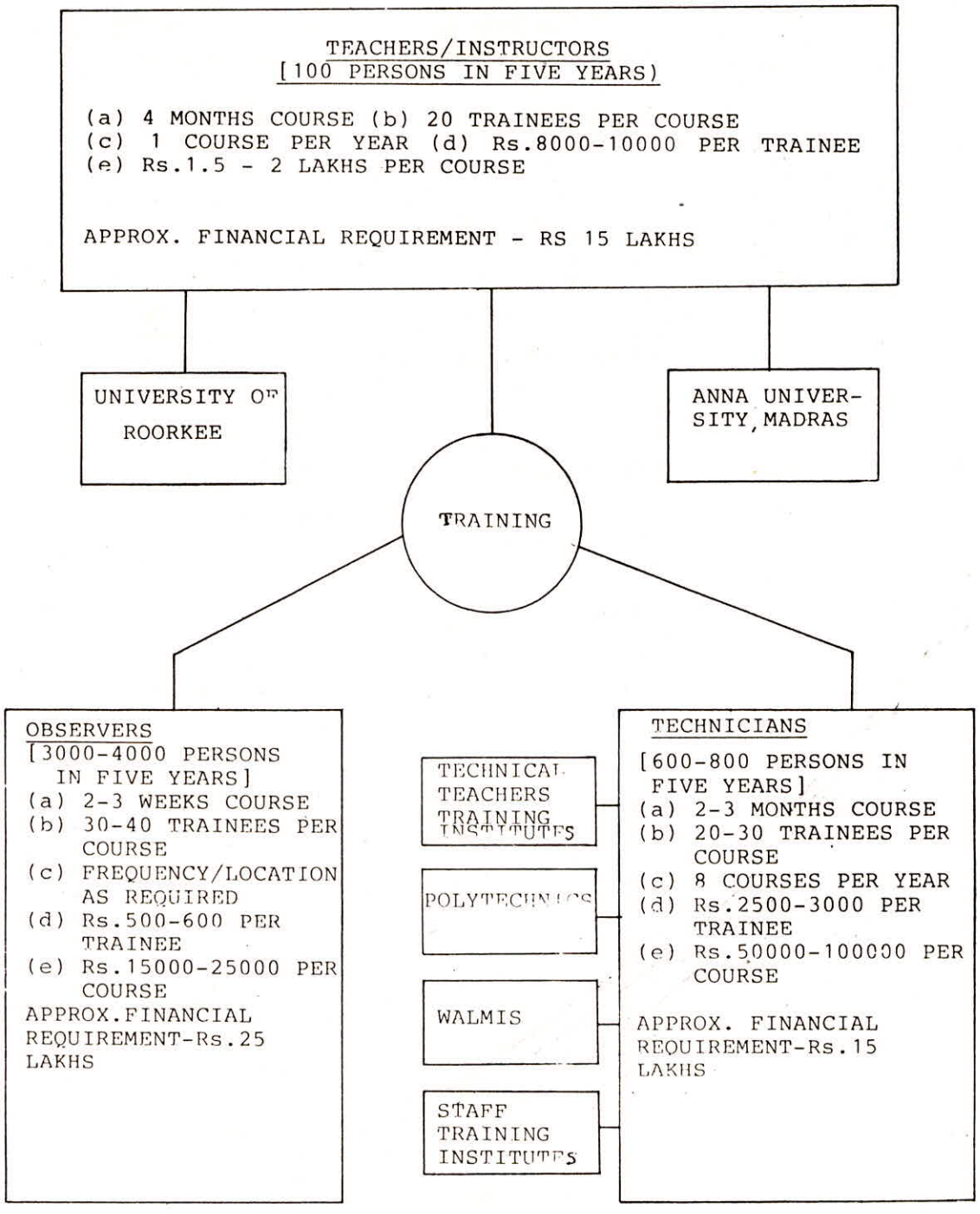

FIG.1 - ACTION PLAN

REMARKS

These financial requirements are indicative of the order of magnitude of funds needed for implementing the proposed action plan for fulfilling the longfelt need for an integrated training programme of subprofessionals for various hydrological measurements and investigations. It is hoped that useful discussions will generate and some definite programme would be taken up in the country in this direction.

REFERENCES

Arccoh Newsletter (1985),"Newsletter of Asian Regional Coordinating Committee on Hydrology", Arccoh Secretariate, NIH, Roorkee, Vol.2, No.2.

Arccoh Newsletter (1986),"Newsletter of Asian Regional Coordinating Committee on Hydrology", Arccoh Secretariate, NIH, Roorkee, Vol.3, No.2.

Central Water Commission (1987), "Water Resources of India, Published by Govt. of India, New Delhi.

Chawla, A.S.(1987),"Water Resources Manpower Development,' Proceedings, First National Water Convention, New Delhi, Vol.1.

Hiltech (1983), "Agenda Papers and Minutes of First Meeting of High Level Technical Committee on Hydrology," held on 22nd February.

Hiltech (1987),"Agenda Papers and Minutes of Tenth Meeting of High Level Technical Committee on Hydrology" held on 9th July.

National Water Policy (1987), Ministry of Water Resources, Government of India, New Delhi.

Rao, K.L.(1975),"India's Water Wealth", Orient Longman, New Delhi.

Shah, R.B.(1987),"Water Resources Development Scenerio for India", CBIP Diamond Jubilee Commemorative Volume.